AMENDMENT TRANSMITTAL LETTER

Docket No. M4065.0315/P315

Application No.	Filing Date	Examiner	Art Unit
09/651,998	August 31, 2000	H. Tsai	2812

Applicant(s): Lingyi A. Zheng et al.

Invention: METHOD AND STRUCTURE FOR REDUCING LEAKAGE CURRENT IN CAPACITORS

TO THE COMMISSIONER FOR PATENTS

Transmitted herewith is an Amendment Under 37 CFR 1.116 in the above-identified application.

The fee has been calculated as shown below.

CLAIMS AS AMENDED					
	Claims Remaining After Amendment	Highest Number Previously Paid	Number Extra Claims Present	Rate	
Total Claims	85	- 95 =	0	x	
Independent Claims	3	- 7 =	0	x	
Multiple Dependent Claims (check if applicable)	☐				
Other fee (please specify):					
TOTAL ADDITIONAL FEE FOR THIS AMENDMENT:					0

[x] Large Entity [ ] Small Entity

[x] No additional fee is required for this Amendment.

[ ] Please charge Deposit Account No. _____ in the amount of $ _____.
A duplicate copy of this sheet is enclosed.

[x] A check in the amount of $ 110.00 (extension of time) to cover the filing fee is enclosed.

[x] The Commissioner is hereby authorized to charge and credit Deposit Account No. 04-1073 as described below.

[x] Credit any overpayment.

[x] Charge any additional filing or application processing fees required under 37 CFR 1.16 and 1.17.

Dated: March 27, 2002

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Docket No.: M4065.0313/P315
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Lingyi A. Zheng et al.

Application No.: 09/651,998 Group Art Unit: 2812

Filed: August 31, 2000 Examiner: H. Tsai

For: METHOD AND STRUCTURE FOR REDUCING LEAKAGE CURRENT IN CAPACITORS

AMENDMENT UNDER 37 C.F.R. § 1.116

ATTN: Box AF
Commissioner for Patents
Washington, DC 20231

Dear Sir:

In response to the Office Action dated November 30, 2001 (Paper No. 9), finally rejecting claims 1-59, please amend the above-captioned application as follows:

In the Claims:

Cancel claims 60-95 without prejudice.

Please replace claims 1 and 40 with amended claims 1 and 40 below.

1. (Amended) A method of forming a capacitor on a substrate in a semiconductor device, comprising:

forming a first layer of a conductive material over said substrate;

forming a second layer of a dielectric over said first layer;

creating a mixture of hydrogen gas and oxygen gas;

introducing said mixture into a chamber containing said substrate;

introducing nitrous oxide gas into said chamber;

contacting said second layer with said mixture and said nitrous oxide gas so as to form an oxidation layer over said second layer; and

forming a third layer of conductive material over said second layer.

40. (Amended) A method of forming a capacitor structure in a semiconductor device, comprising:

depositing a layer of silicon nitride over a conductive layer formed over a substrate;

creating a mixture of hydrogen gas and oxygen gas;

introducing said mixture into a chamber containing said substrate;

introducing nitrous oxide gas into said chamber;

contacting said silicon nitride layer with said mixture and said nitrous oxide gas so as to form an oxidation layer over said silicon nitride layer.

Please add new claims 96-121 as follows:

96. A method of forming a capacitor on a substrate in a semiconductor device, comprising;

forming a first layer of a conductive material over said substrate;

forming a second layer of a dielectric over said first layer;

contacting said second layer, during a thermal process, with hydrogen, oxygen and nitrous oxide gases so as to form an oxidation layer over said second layer; and

forming a third layer of conductive material over said second layer.

97. The method of claim 96, wherein said second layer is formed to a thickness not exceeding about 60 Angstroms.

98. The method of claim 96, wherein said second layer is formed to a thickness not exceeding about 50 Angstroms.

99. The method of claim 98, wherein said second layer is formed to a thickness within the range of about 45 to 50 Angstroms.

100. The method of claim 96, wherein the ratio of nitrous oxide to oxygen and hydrogen respectively is in the range of about .05 to about 1.7.

101. The method of claim 100, wherein said contacting is performed with a gas flow rate of at least about 0.5 slm for said nitrous oxide.

102. The method of claim 101, wherein said contacting is performed with a gas flow rate of at least about 2.5 slm for said nitrous oxide.

103. The method of claim 102, wherein said contacting is performed with a gas flow rate of at least about 5 slm for said nitrous oxide.

104. The method of claim 96, wherein said contacting is performed at a temperature within the range of about 600 to 1000°C.

105. The method of claim 104, wherein said contacting is performed at a temperature within the range of about 700 to 900 °C.

106. The method of claim 105, wherein said contacting is performed at a temperature within the range of about 700 to 800 °C.

107. The method of claim 96, wherein said oxidation layer is formed so as to be thinner than said dielectric layer.

108. The method of claim 107, wherein said oxidation layer is formed to a thickness less than about 5 Angstroms.

109. The method of claim 107, wherein said oxidation layer is formed to a thickness less than about 3 Angstroms.

110. The method of claim 96, wherein said contacting is performed with a gas flow rate within the range of about 1 to 15 slm for each of said hydrogen, oxygen and nitrous oxide gases.

111. The method of claim 110, wherein said contacting is performed with a gas flow rate within the range of about 2 to 10 slm for each of said hydrogen, oxygen and nitrous oxide gases.

112. The method of claim 111, wherein said contacting is performed at a temperature within the range of about 600 to 1000°C.

113. The method of claim 112, wherein said contacting is performed at a gas flow rate for said oxygen which is within the range of about 4 to 8 slm.

114. The method of claim 113, wherein said contacting is performed at a gas flow rate for said hydrogen which is within the range of about 4 to 8 slm.

115. The method of claim 114, wherein said contacting is performed at a gas flow rate within the range of about 4 to 8 slm for each of said oxygen and hydrogen.

116. The method of claim 112, wherein said contacting is performed at a gas flow rate within the range of about 2.5 to 10 slm.

117. The method of claim 116, wherein said contacting is performed at a gas flow rate within the range of about 6 to 10 slm.

118. The method of claim 112, wherein said contacting is performed at a temperature within the range of about 700 to 800°C.

119. The method of claim 118, wherein said contacting is performed at a gas flow of about 6 slm for said hydrogen, about 6 slm for said oxygen, and about 2.5 slm for said nitrous oxide.

120. The method of claim 118, wherein said contacting is performed at a gas flow rate of about 6 slm for said hydrogen, about 6 slm for said oxygen, and within the range of about 1 to 15 slm for said nitrous oxide.

121. The method of claim 118, wherein said oxidation layer is formed to be thinner than said dielectric layer.